ASIAEX* South China Sea
Acoustic Fluctuations (and Physical Oceanography)

Tim Duda*, Lixin Wu°, Jim Lynch*

AOPE Department

*Woods Hole Oceanographic Institution, USA**

National Laboratory of Acoustics

Academia Sinica, Beijing, PRC°

Report Documentation Page

Form Approved
OMB No. 0704-0188

Public reporting burden for the collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to a penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.

1. REPORT DATE	2. REPORT TYPE	3. DATES COVERED
01 DEC 2002	**N/A**	**-**

4. TITLE AND SUBTITLE	5a. CONTRACT NUMBER
ASIAEX South China Sea Acoustic Fluctuations (and Physical Oceanography	**N00014-99-1-0275**
	5b. GRANT NUMBER
	5c. PROGRAM ELEMENT NUMBER
6. AUTHOR(S)	5d. PROJECT NUMBER
	5e. TASK NUMBER
	5f. WORK UNIT NUMBER
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) **AOPE Department, Woods Hole Oceanographic Institution, USA, National Laboratory of Acoustics, Academia Sinica, Beijing, PRC**	8. PERFORMING ORGANIZATION REPORT NUMBER
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)	10. SPONSOR/MONITOR'S ACRONYM(S)
	11. SPONSOR/MONITOR'S REPORT NUMBER(S)

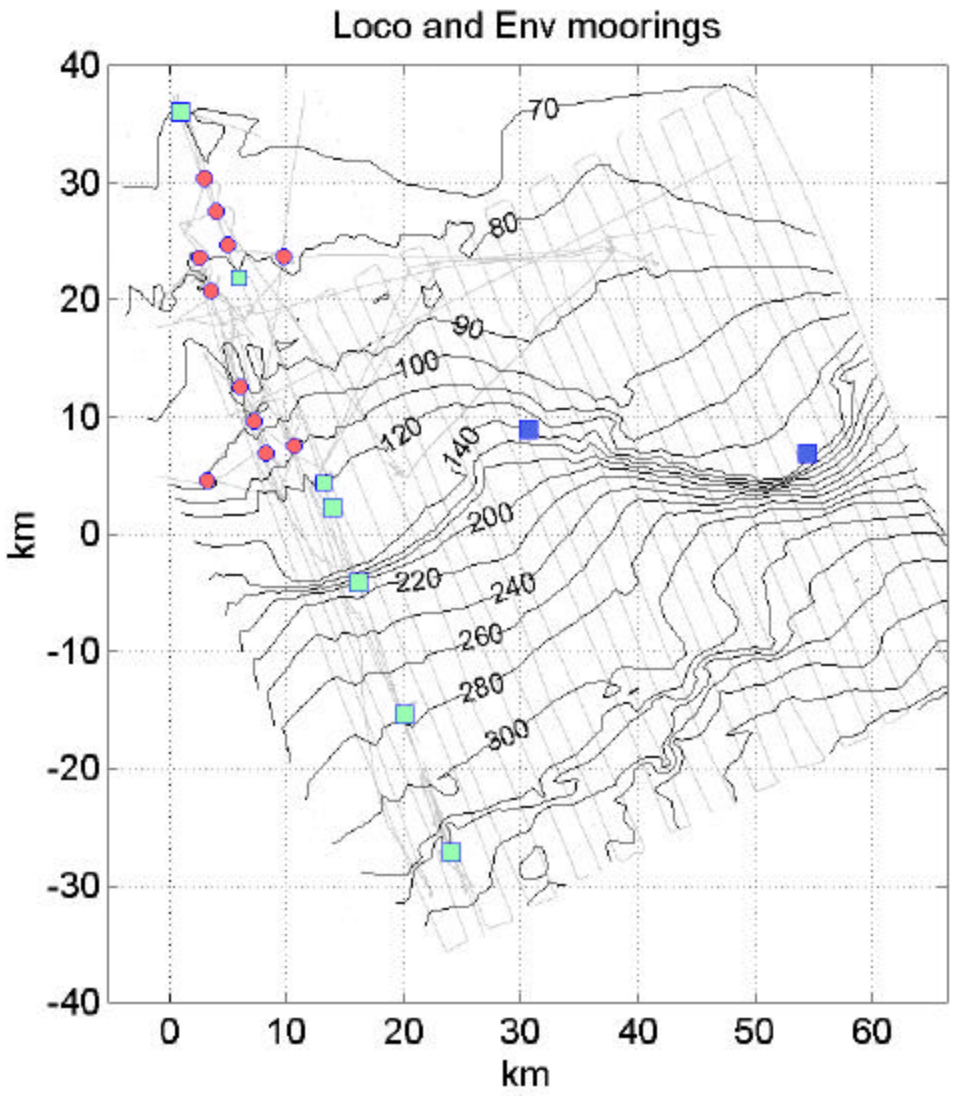
12. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release, distribution unlimited

13. SUPPLEMENTARY NOTES
Also see: M001452, The original document contains color images.

14. ABSTRACT

15. SUBJECT TERMS

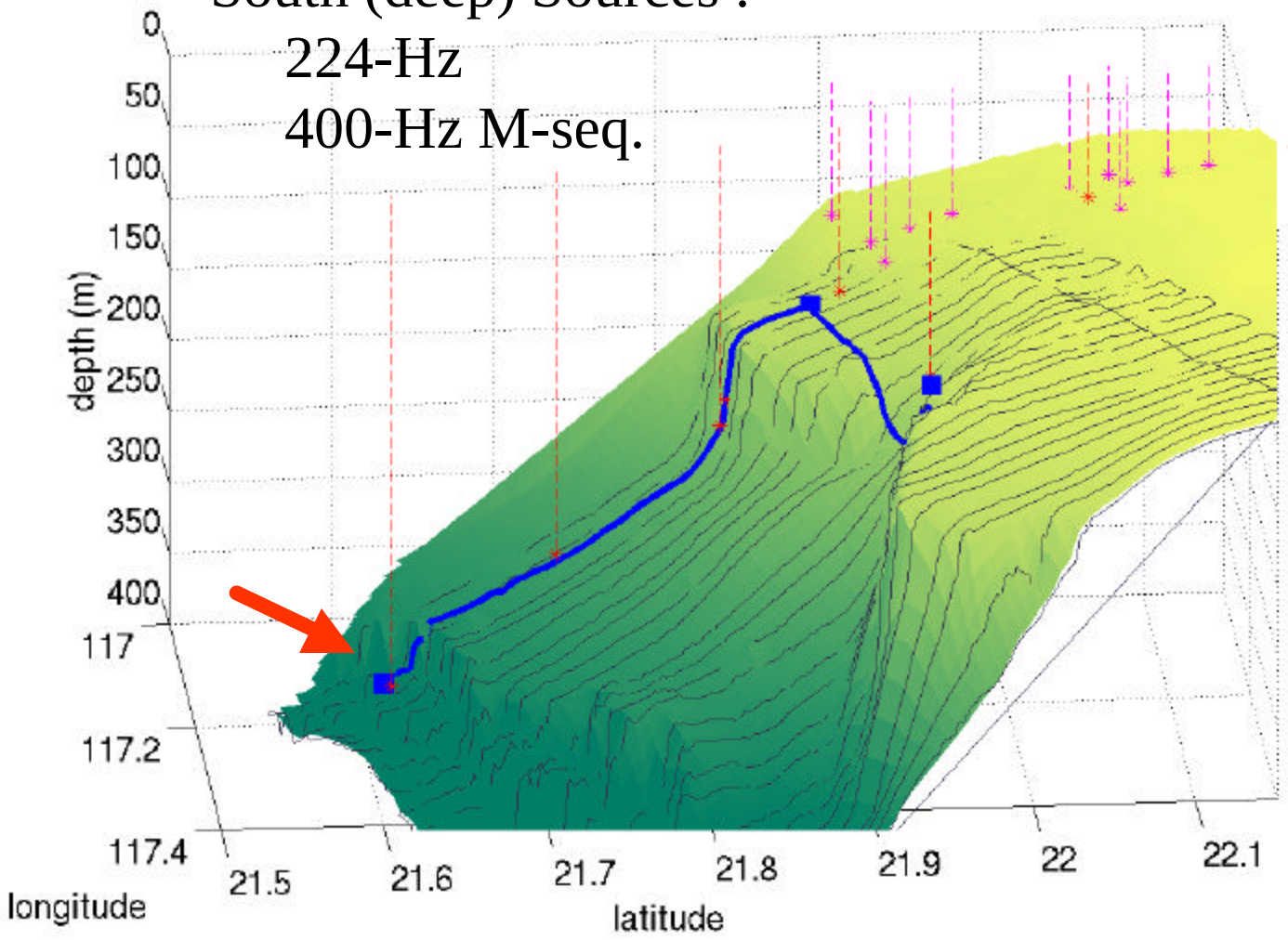
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT **unclassified**	b. ABSTRACT **unclassified**	c. THIS PAGE **unclassified**	**UU**	**21**	


Loco and Env moorings
40
30
20
10
0
-10
-20
-30
-40
km
0
10
20
30
40
50
60
km
70
80
90
100
120
140
200
220
240
260
280
300

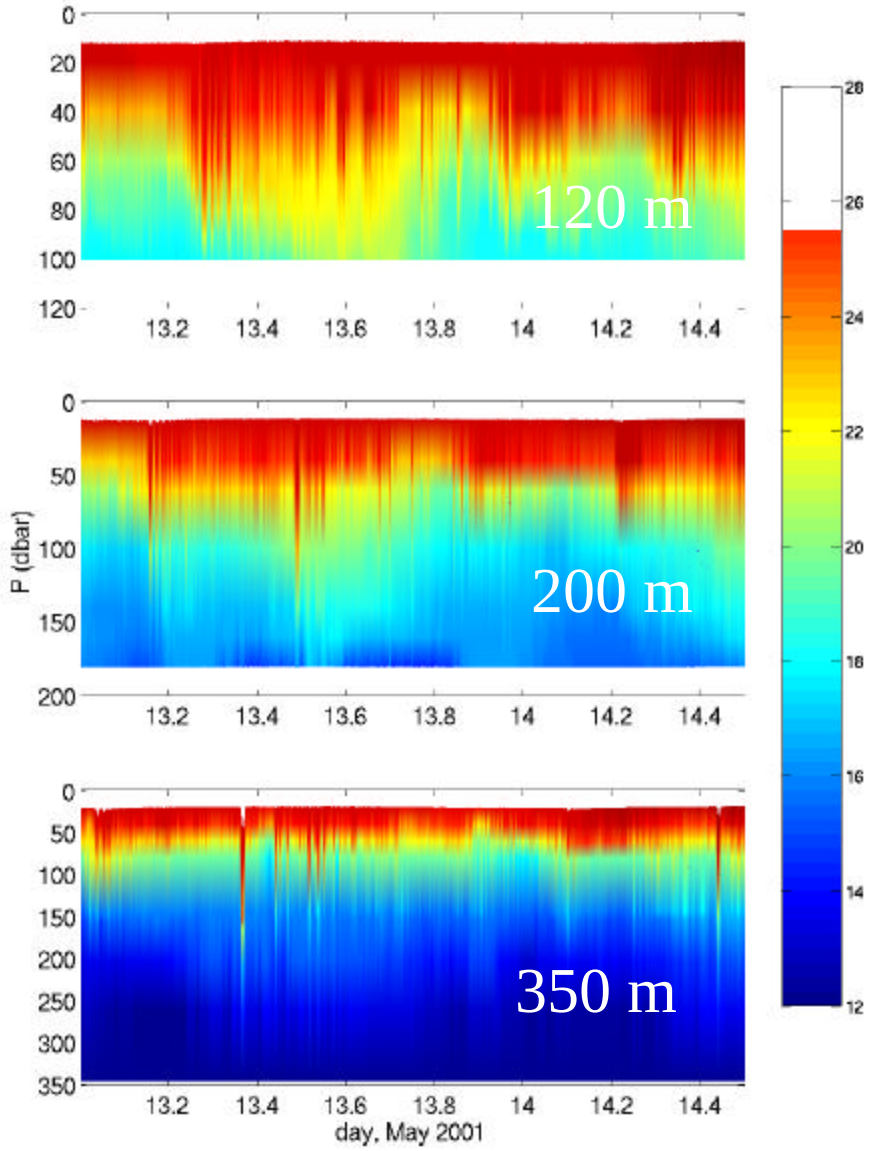
South (deep) Sources :

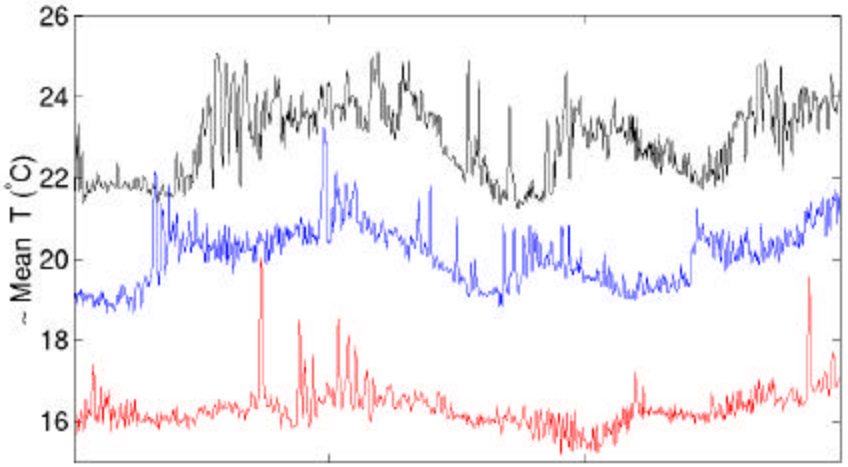
224-Hz

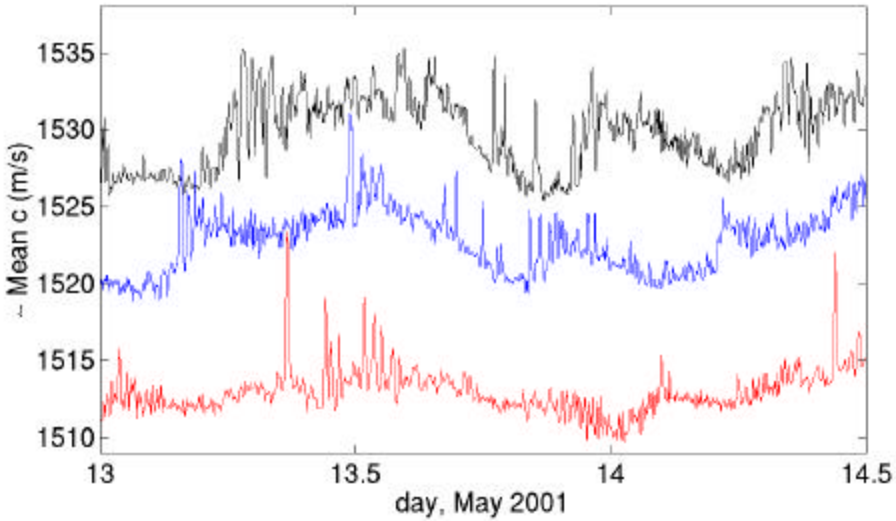
400-Hz M-seq.

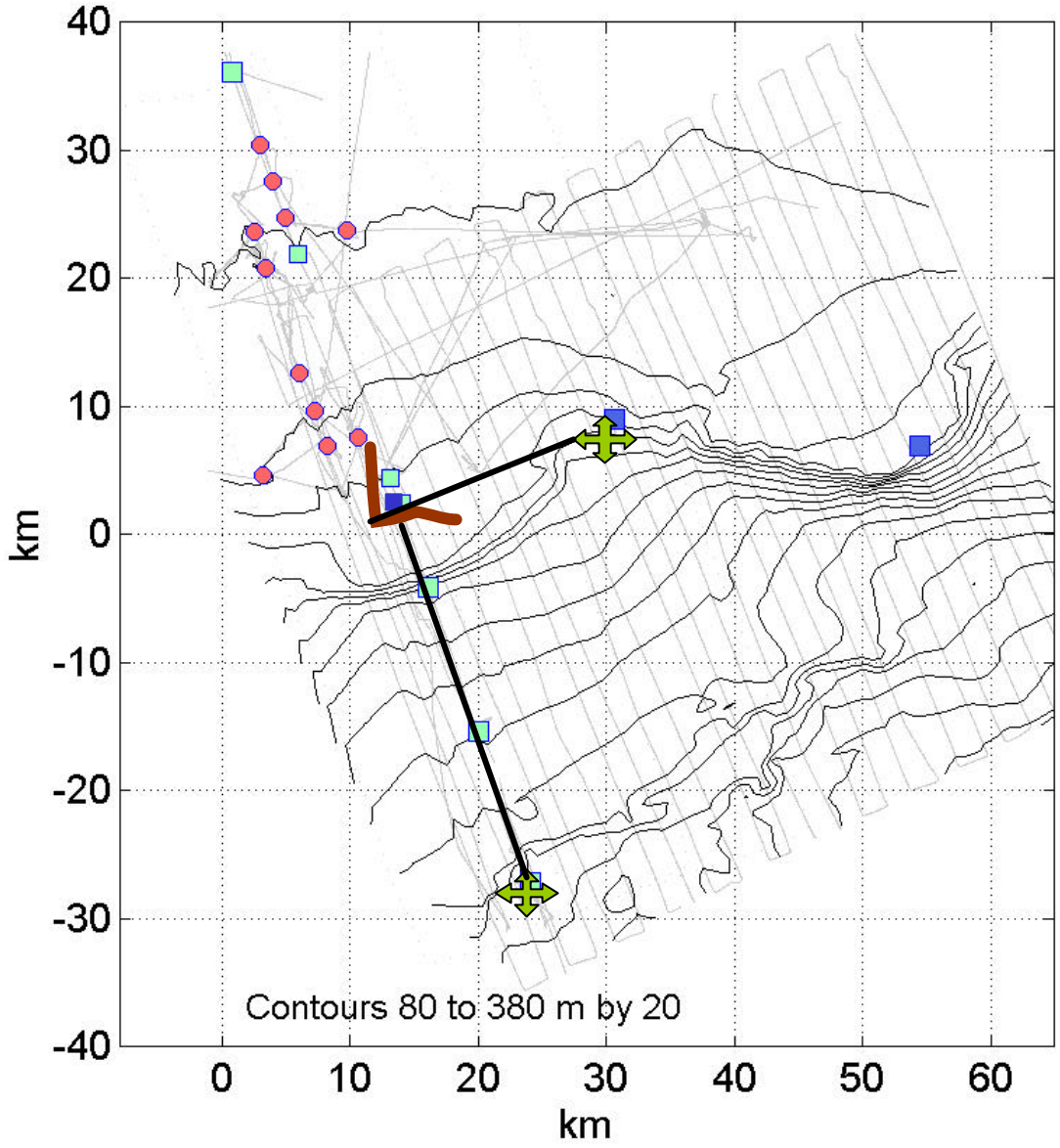


South Line $T(z,t)$ and $c(z,t)$ … $\grave{o}(.)dz$









T/C/P/ADCP

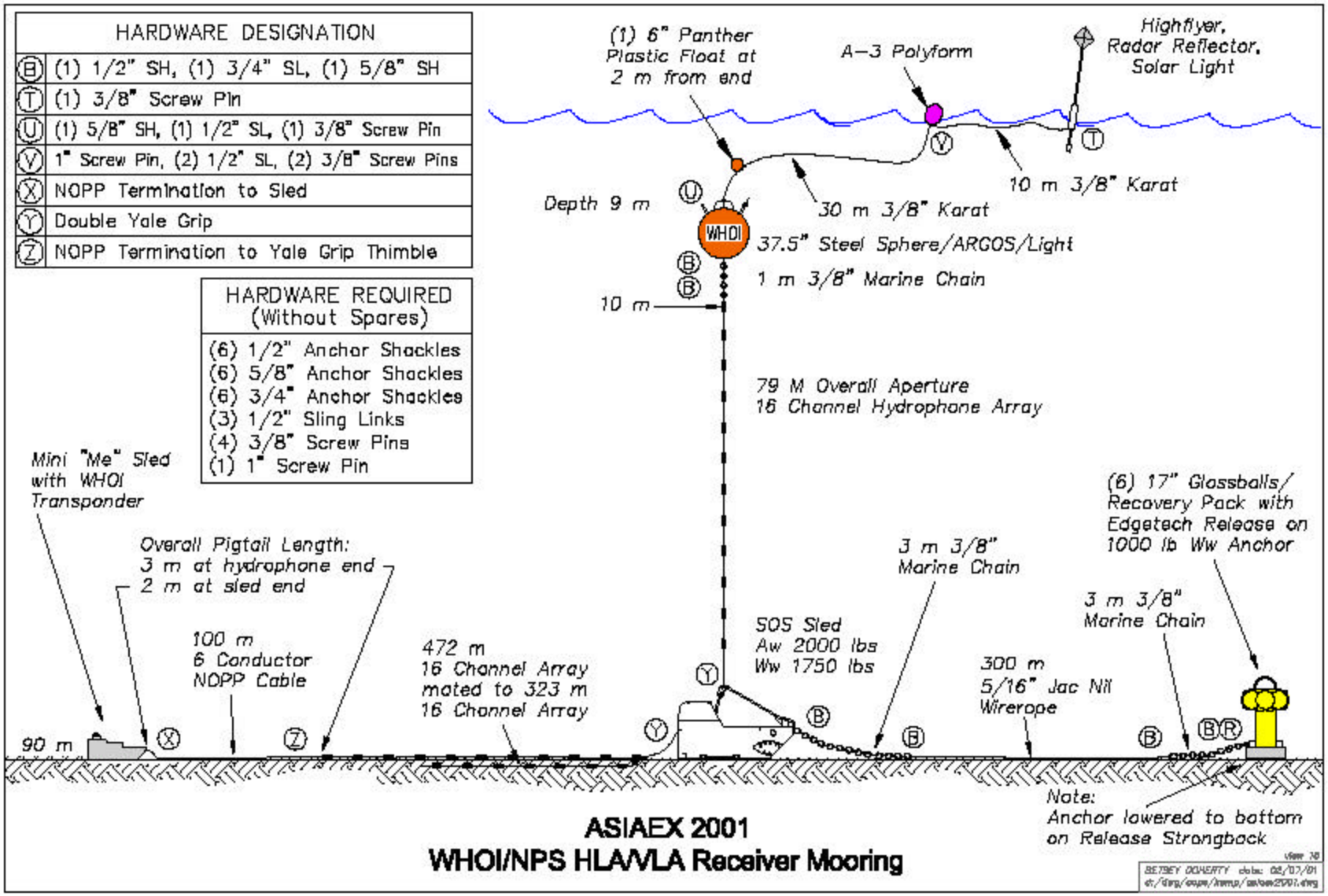
LOCO – T/P

T chain

Projectors

Horiz./vertical line array

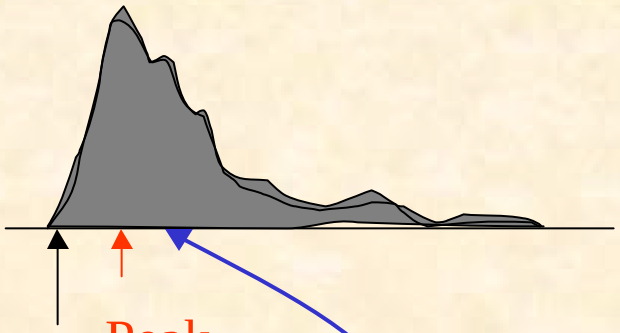
Receive:
2 May 2001—
18 May 2001



124 m depth; VLA 42-121m; HLA: 32 phones@15 m = 465 m

Pulse arrivals

Match Filter output



Peak

Leading edge

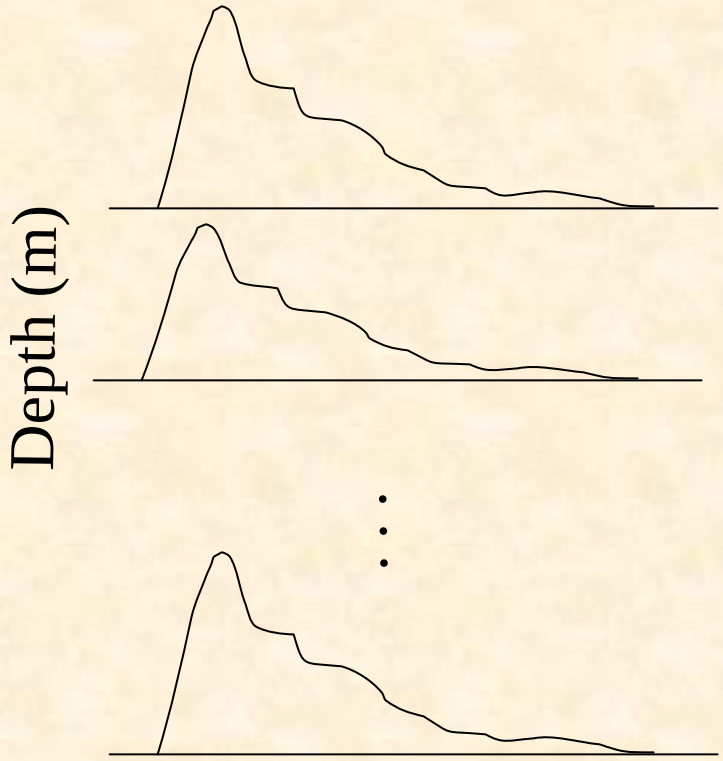
Centroid

$$C = \sum_{t=t_1}^{t_2} a^2 t \cong \int_{t_1}^{t_2} a(t)^2 t dt$$

Energy

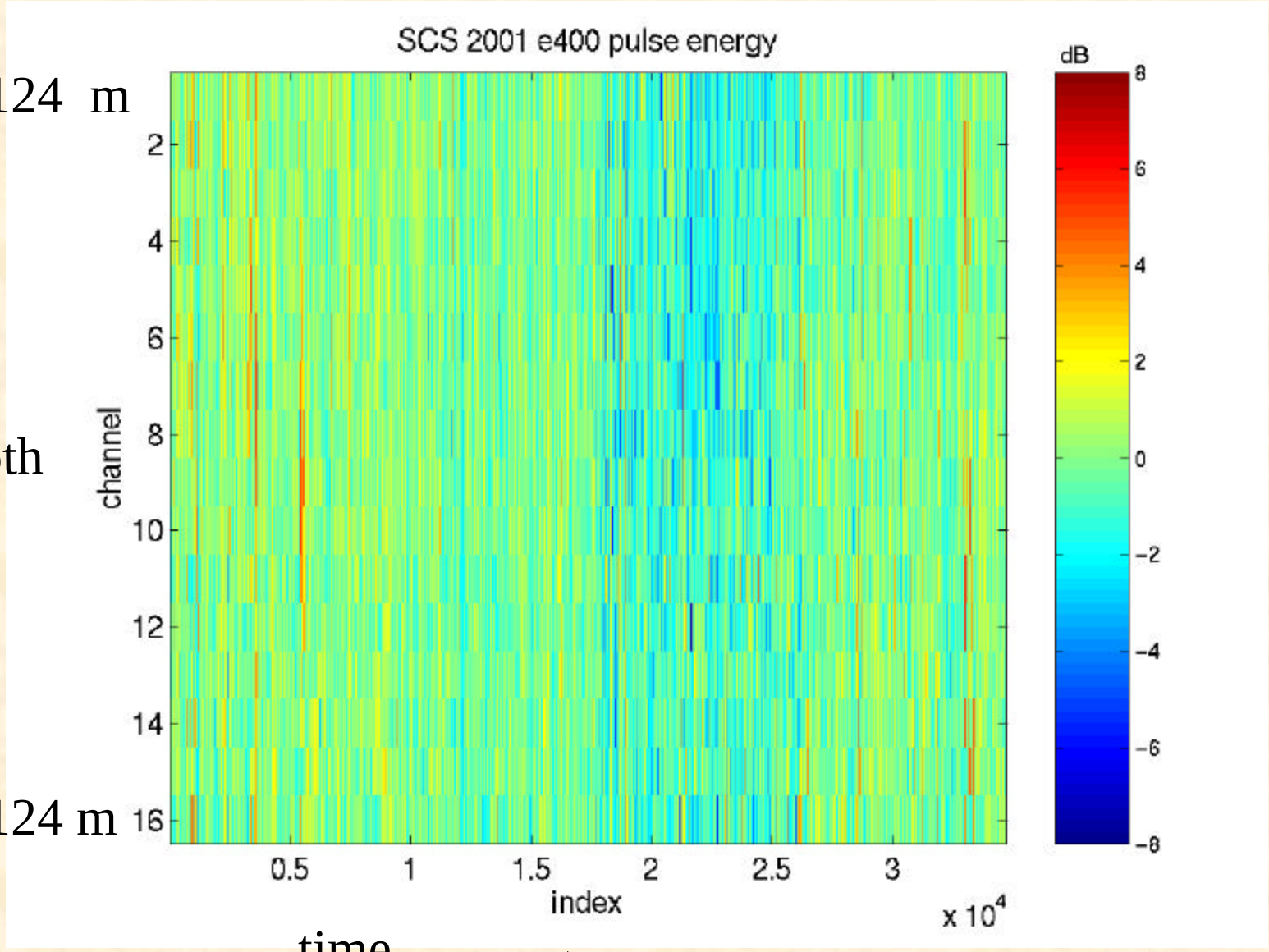
$$E_1 = \sum_{t=t_1}^{t_2} a^2 \cong \int a^2(t) dt$$

Vertical line array

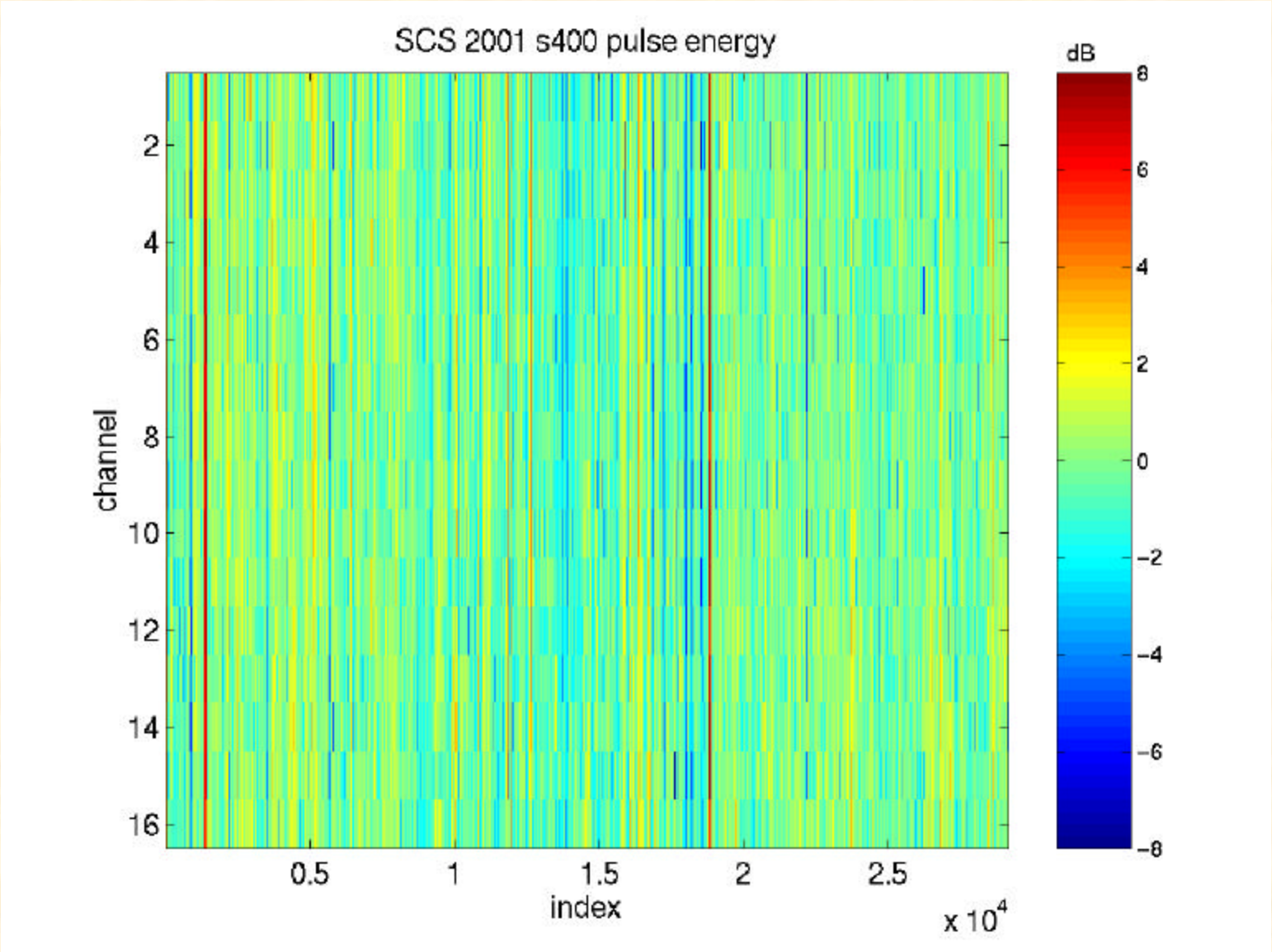


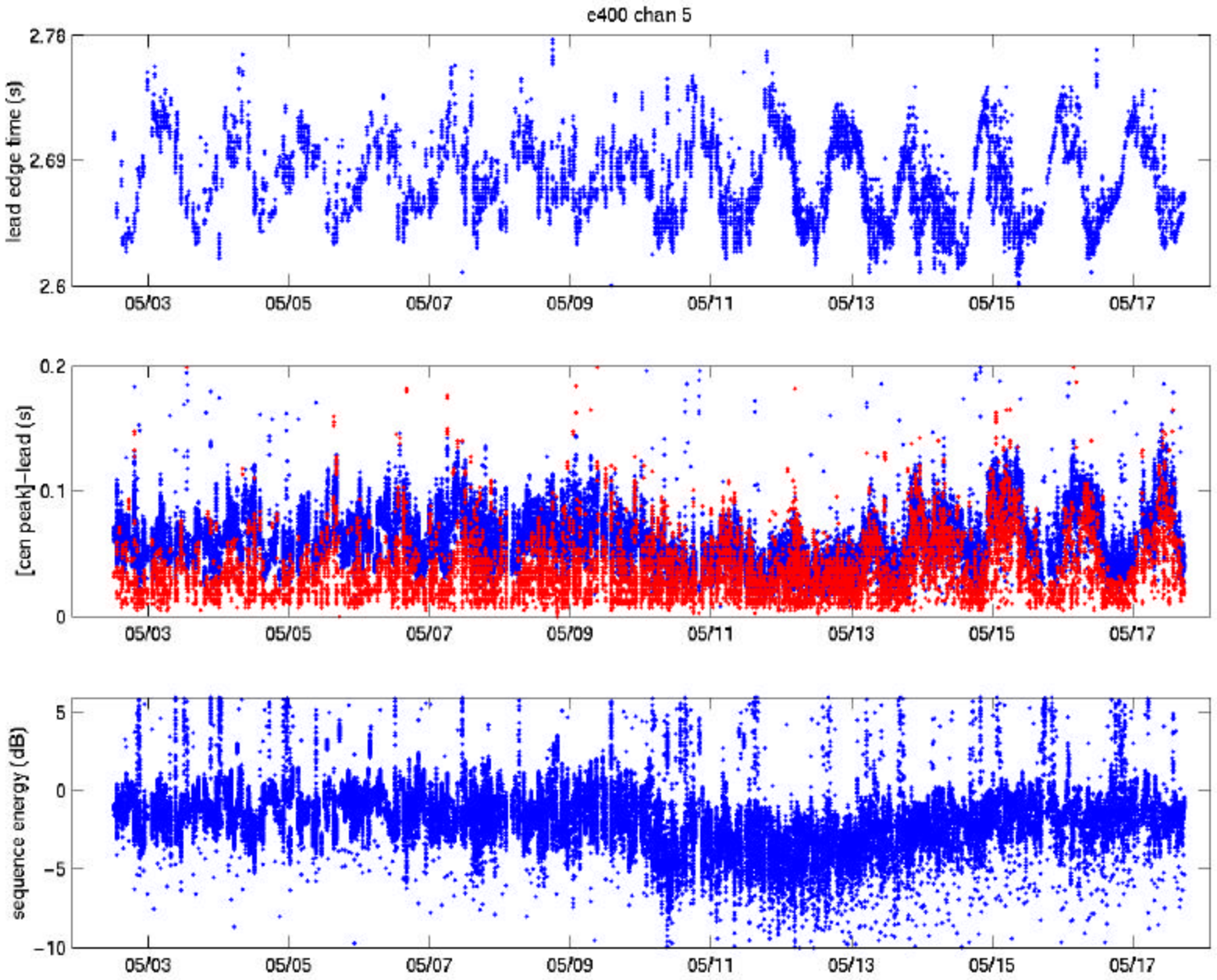
$$E = \sum_{z=z_1}^{z_2} \sum_{t=t_1}^{t_2} a^2 \cong \iint a(t)^2 dt dz$$

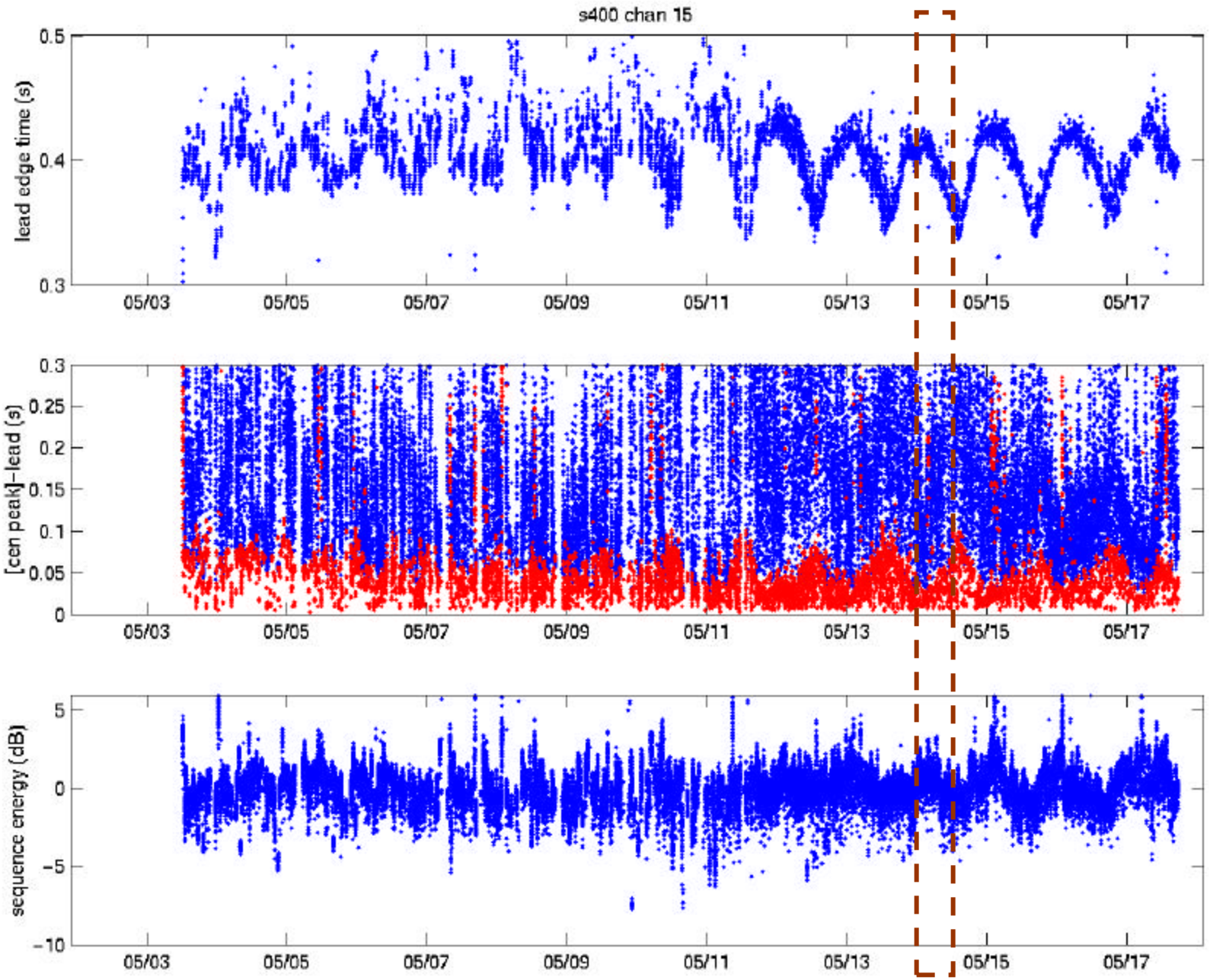
VLA arrivals: Impulse response energy *E* over the16 days, East 400 Hz, vs. depth and time

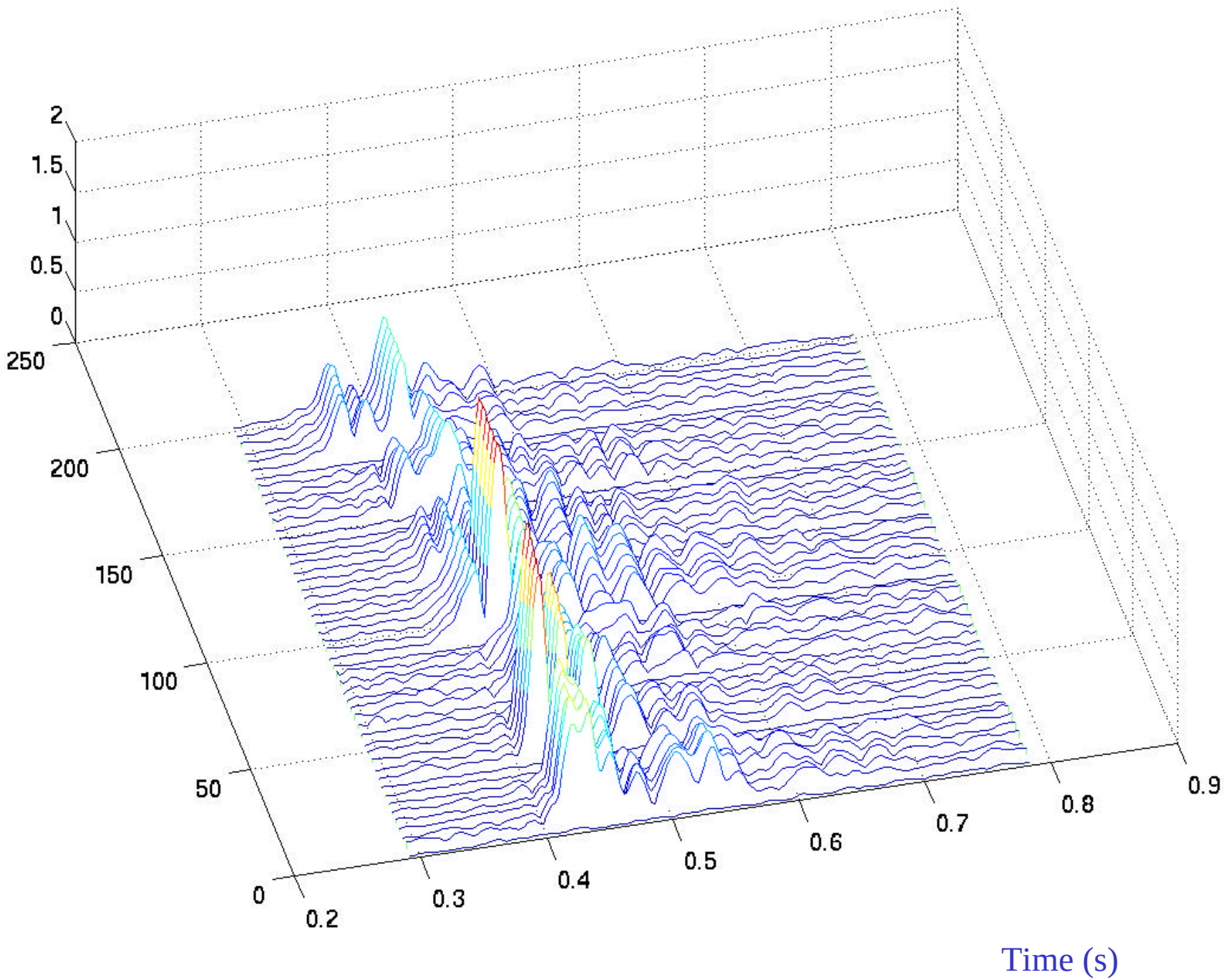


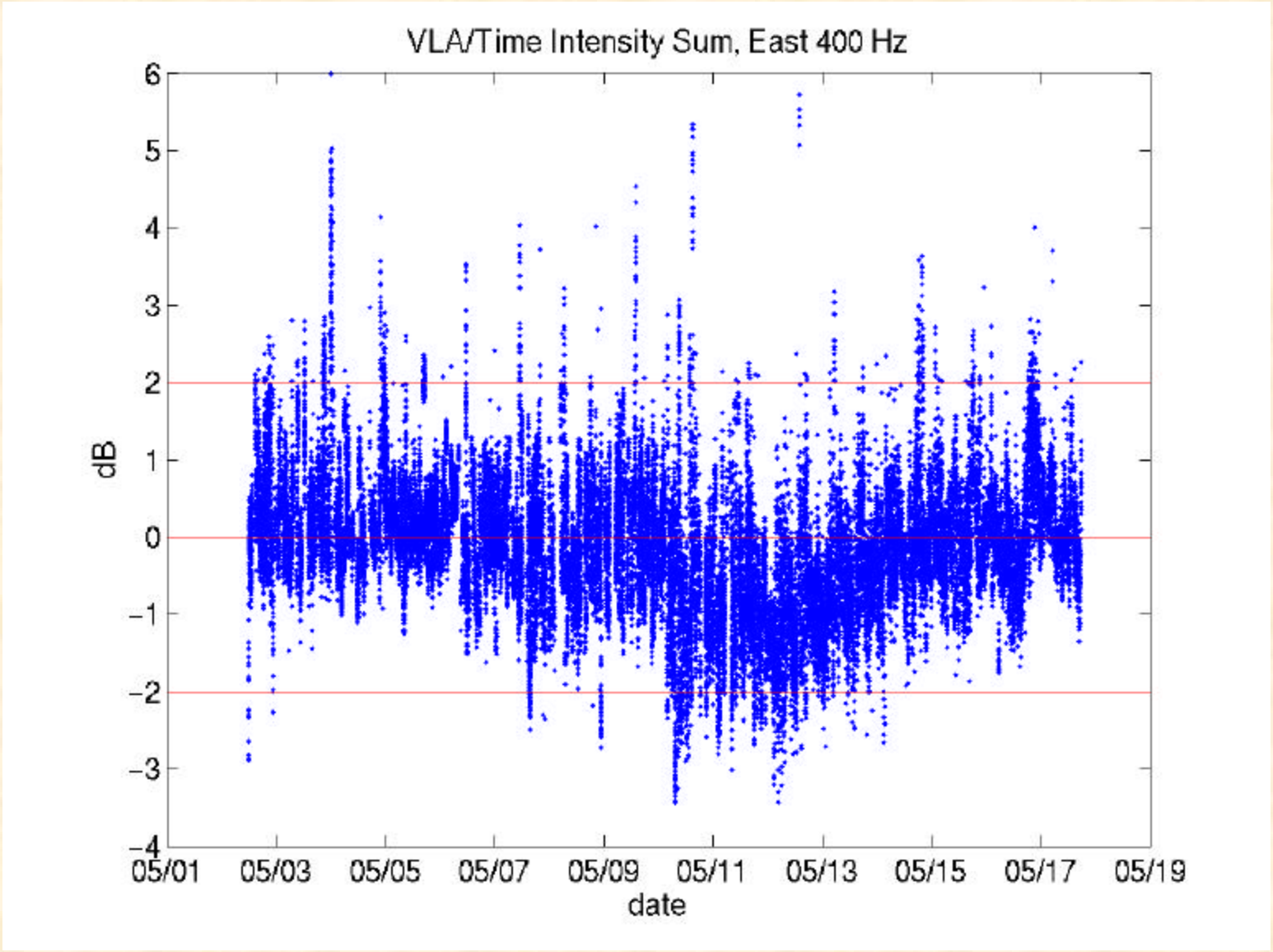
VLA arrivals: Impulse response energy *E* over the16 days, **South** 400 Hz, vs. depth and time

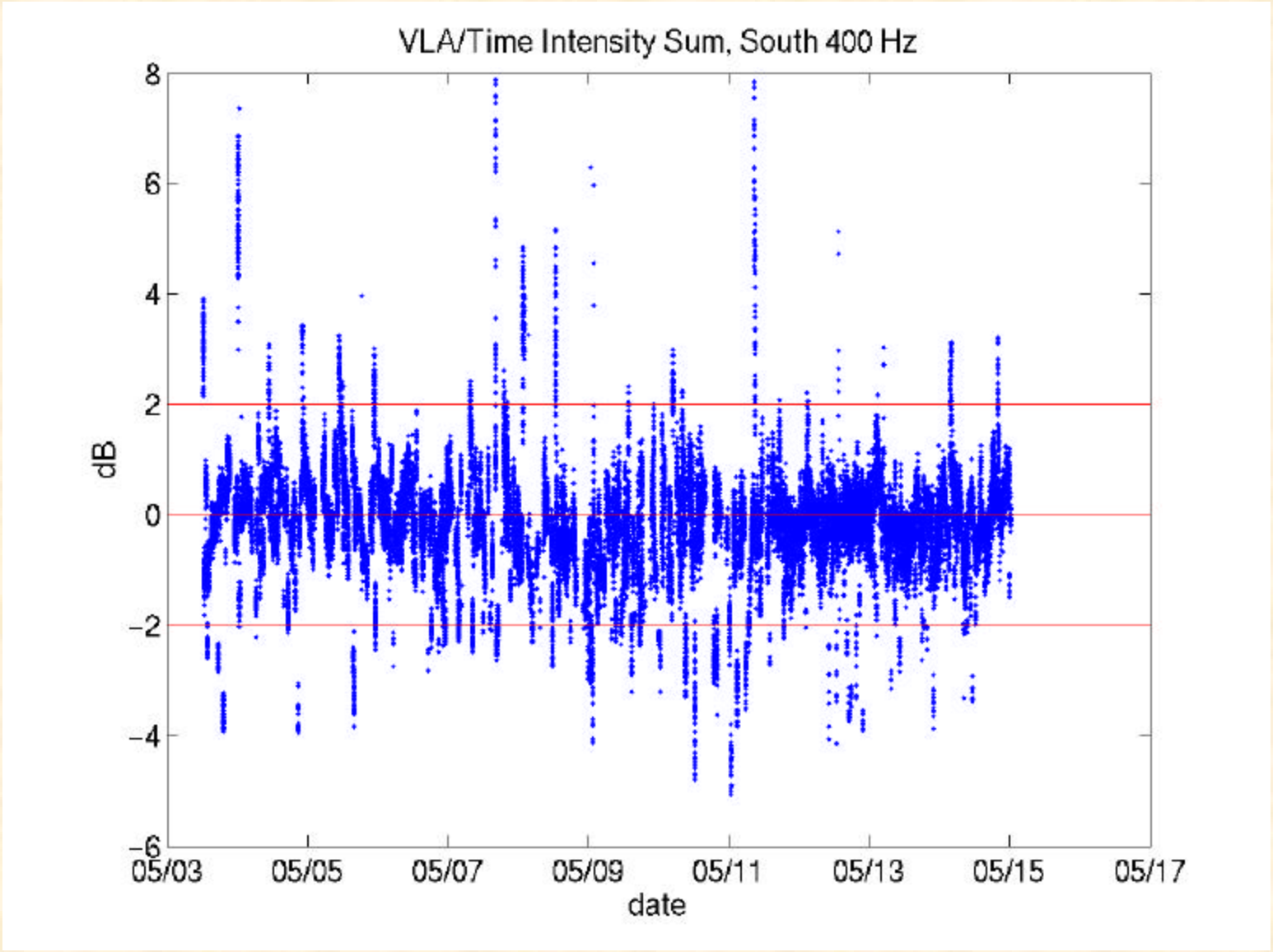


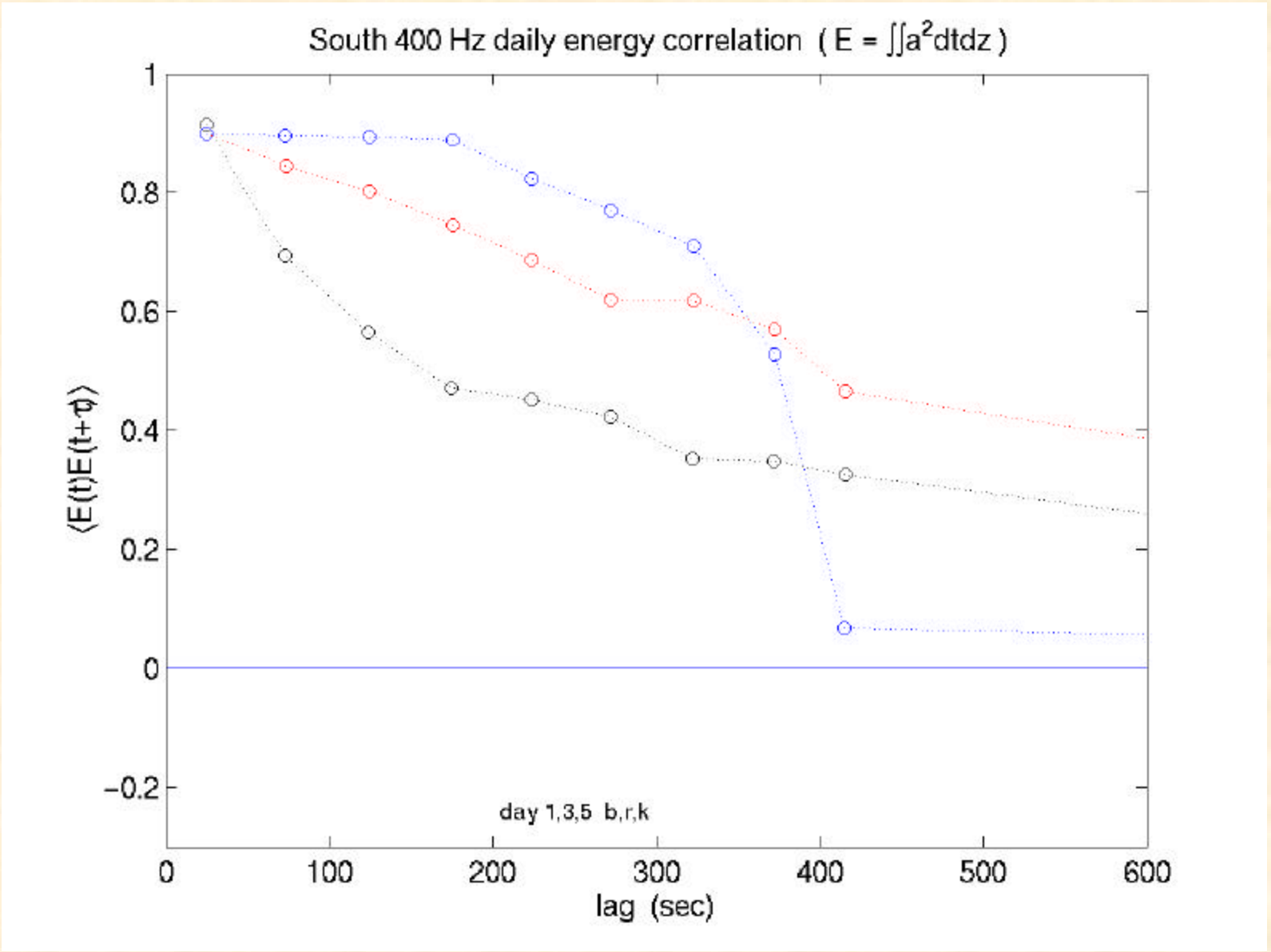

e400 chan 5
lead edge time (s)
2.76
2.69
2.6
[cen peak]−lead (s)
0.2
0.1
0
sequence energy (dB)
5
0
−5
−10
05/03
05/05
05/07
05/09
05/11
05/13
05/15
05/17

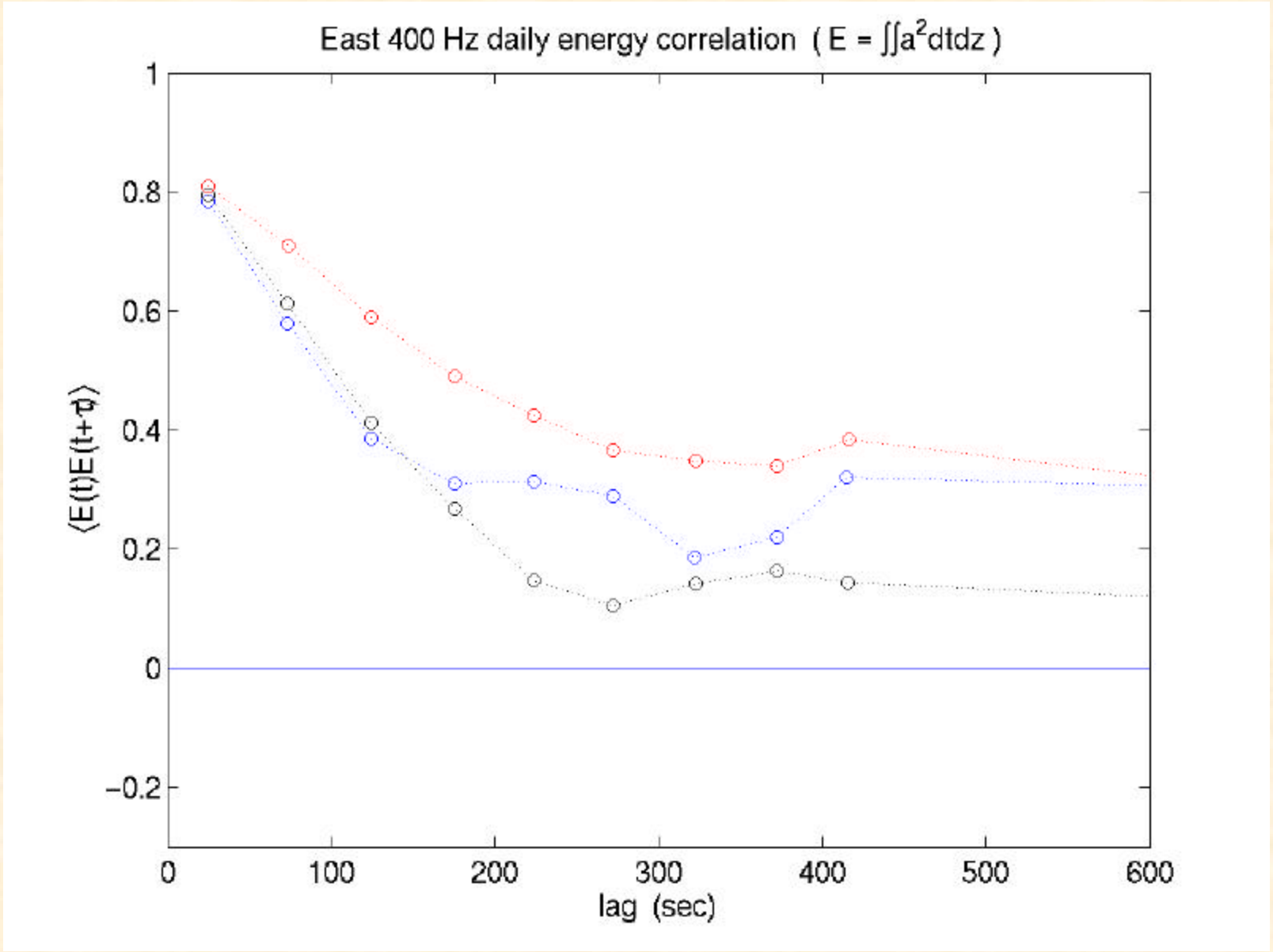

s400 chan 15
lead edge time (s)
0.5
0.4
0.3
05/03
05/05
05/07
05/09
05/11
05/13
05/15
05/17
[cen peak]−lead (s)
0.3
0.25
0.2
0.15
0.1
0.05
0
sequence energy (dB)
5
0
−5
−10

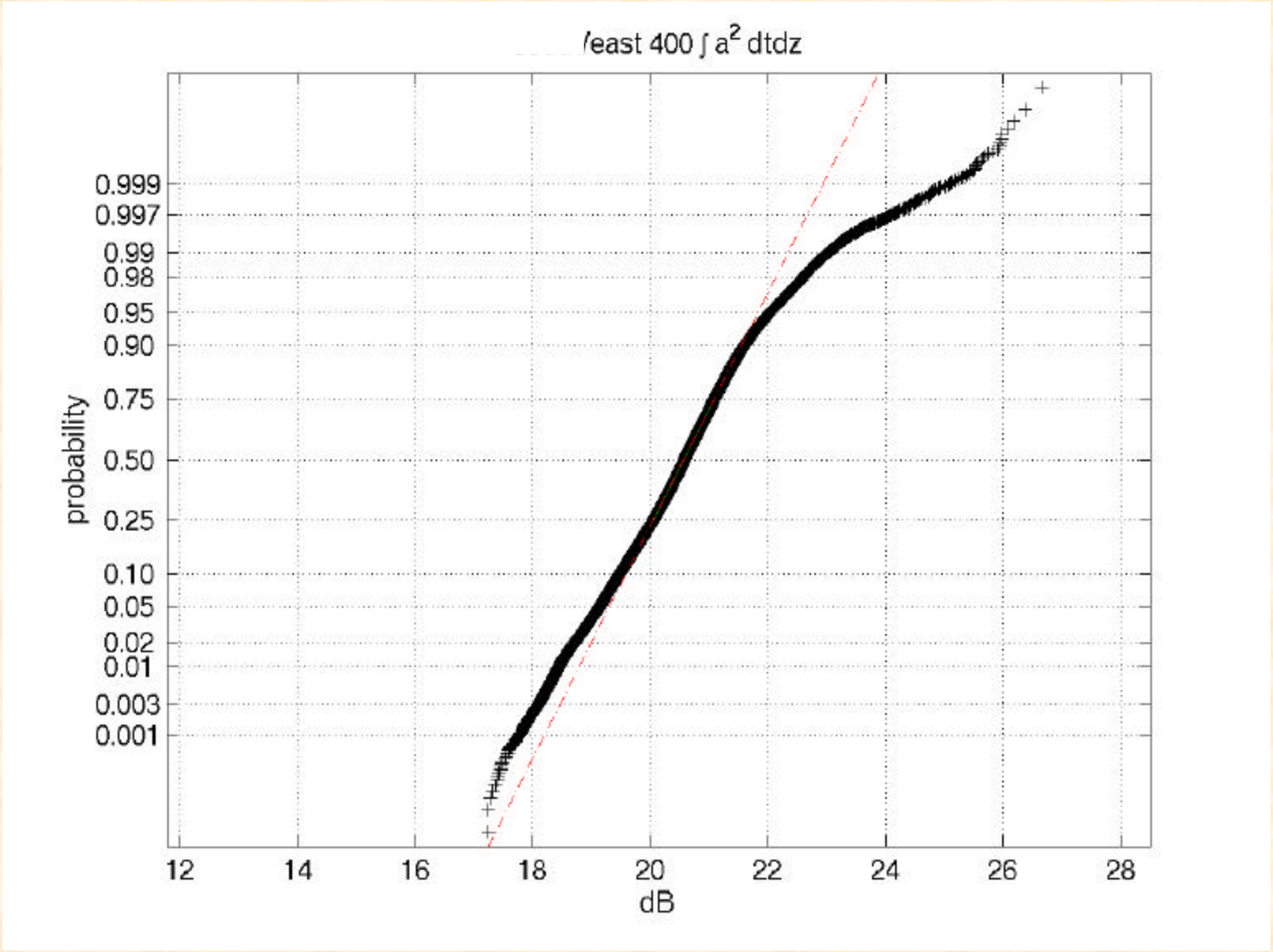

2
1.5
1
0.5
0
250
200
150
100
50
0
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
Time (s)

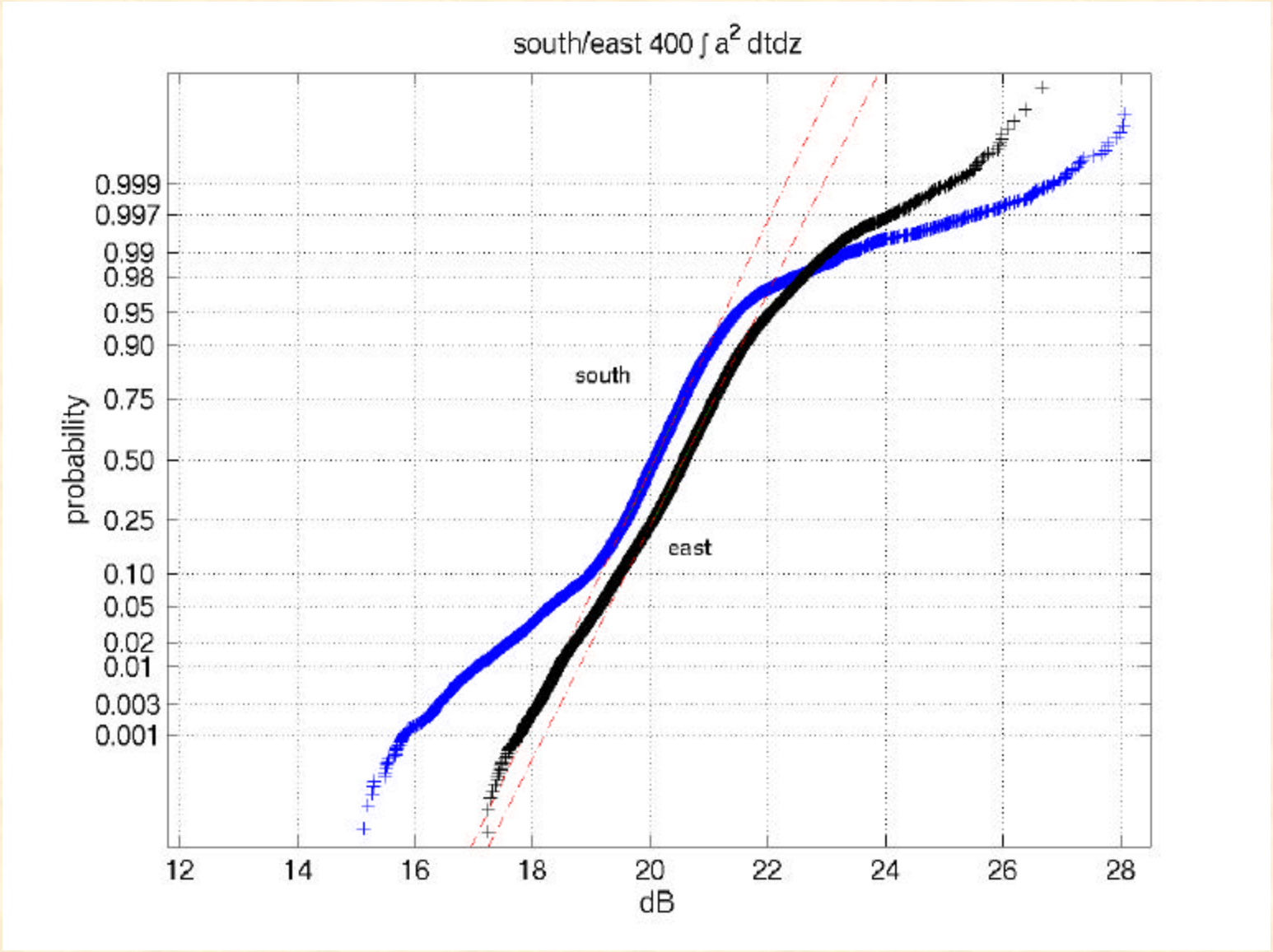

VLA/Time Intensity Sum, East 400 Hz
6
5
4
3
2
1
0
−1
−2
−3
−4
dB
05/01
05/03
05/05
05/07
05/09
05/11
05/13
05/15
05/17
05/19
date

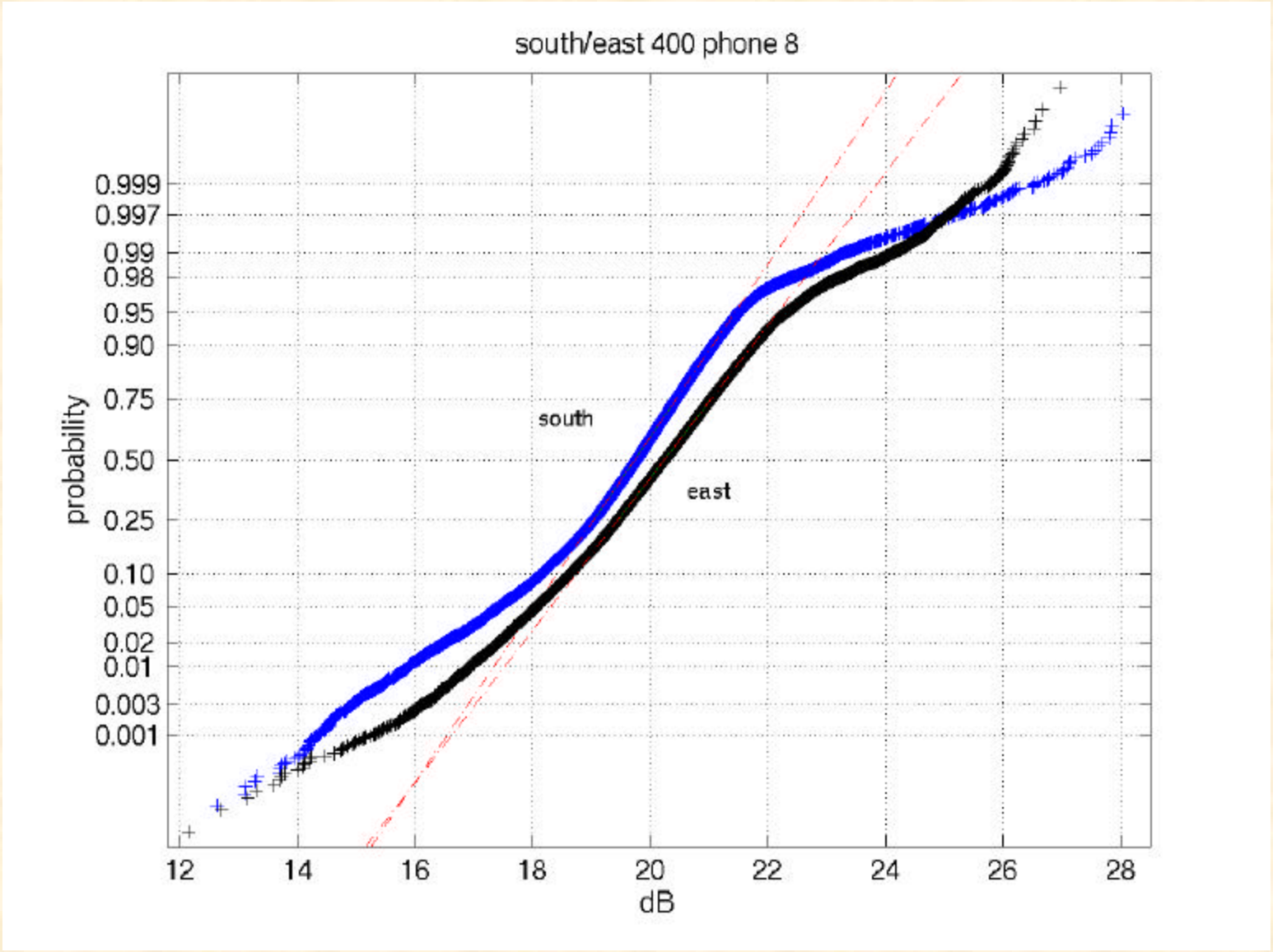

VLA/Time Intensity Sum, South 400 Hz
8
6
4
2
0
−2
−4
−6
dB
05/03
05/05
05/07
05/09
05/11
05/13
05/15
05/17
date

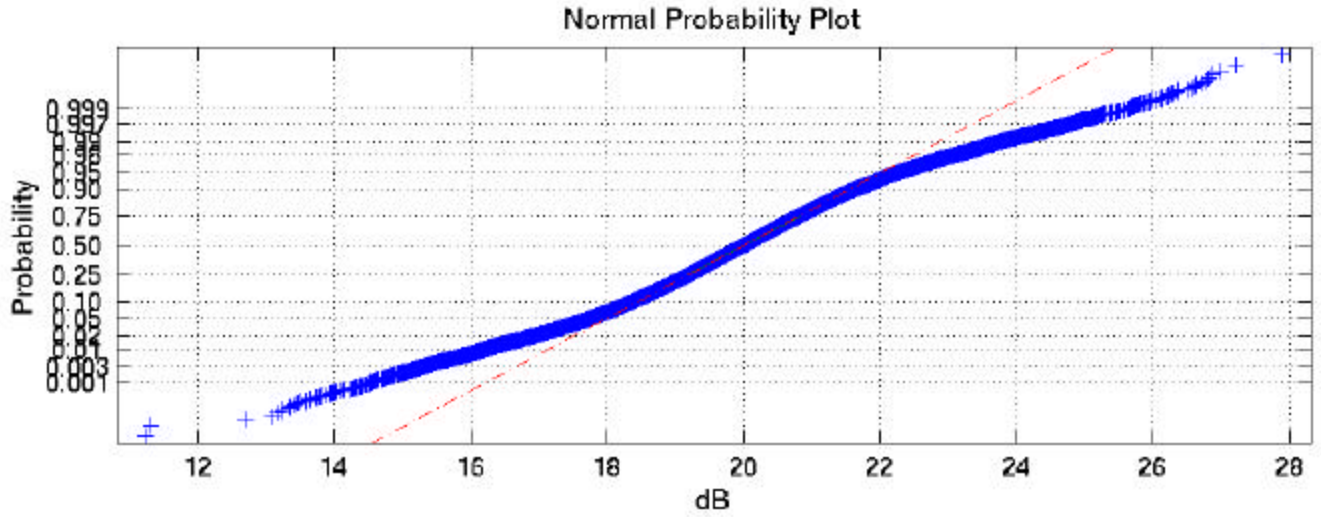

South 400 Hz daily energy correlation (E = ∫∫a²dtdz)
⟨E(t)E(t+τ)⟩
1
0.8
0.6
0.4
0.2
0
−0.2
day 1,3,5 b,r,k
0
100
200
300
400
500
600
lag (sec)

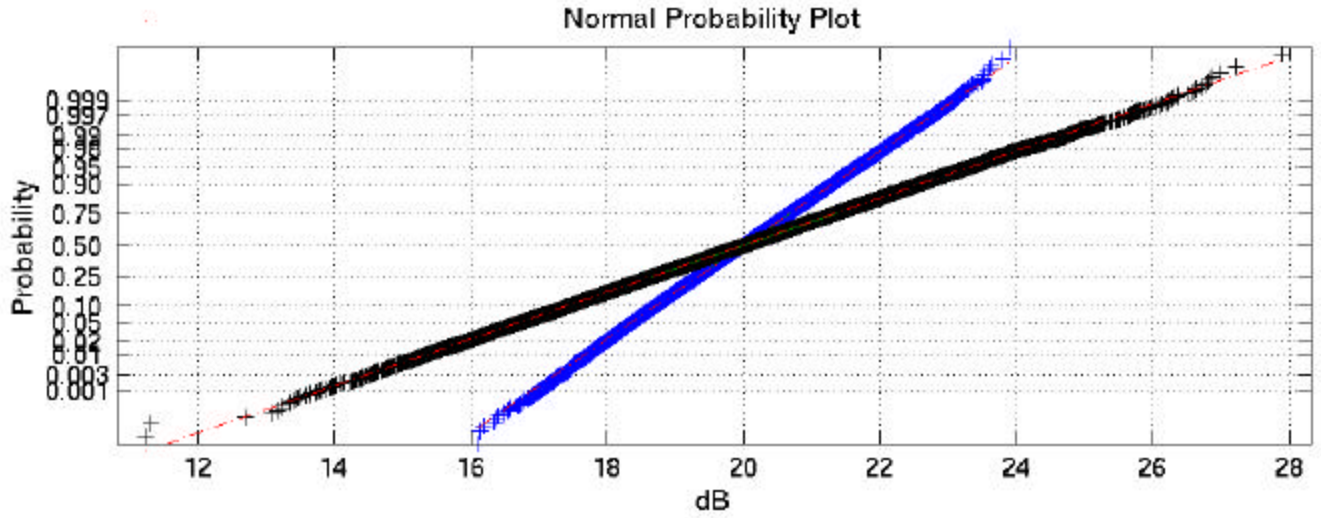

East 400 Hz daily energy correlation (E = ∫∫a²dtdz)
⟨E(t)E(t+τ)⟩
1
0.8
0.6
0.4
0.2
0
−0.2
0
100
200
300
400
500
600
lag (sec)


/east 400 ∫ a² dtdz
probability
0.999
0.997
0.99
0.98
0.95
0.90
0.75
0.50
0.25
0.10
0.05
0.02
0.01
0.003
0.001
12
14
16
18
20
22
24
26
28
dB


south/east 400 ∫ a2 dtdz
probability
0.999
0.997
0.99
0.98
0.95
0.90
0.75
0.50
0.25
0.10
0.05
0.02
0.01
0.003
0.001
south
east
12
14
16
18
20
22
24
26
28
dB


south/east 400 phone 8
probability
0.999
0.997
0.99
0.98
0.95
0.90
0.75
0.50
0.25
0.10
0.05
0.02
0.01
0.003
0.001
south
east
12
14
16
18
20
22
24
26
28
dB


Normal Probability Plot
Probability
0.75
0.50
0.25
0.10
12
14
16
18
20
22
24
26
28
dB


Normal Probability Plot
Probability
0.75
0.50
0.25
0.10
0.003
0.001
12
14
16
18
20
22
24
26
28
dB

Summary

Lots of work left to do !!!